U.S.-RUSSIAN EFFORT DEVELOPS NEW WASTE-TREATMENT TECHNOLOGY

U.S. and Russian scientists have developed a new process for separating highly radioactive and long-lived elements from nuclear waste that is both faster and cheaper than existing separation technologies. The process, known as Universal Extraction, or UNEX, is a solvent-extraction process capable of removing multiple radioactive elements, including cesium-137, strontium-90, plutonium and americium, from high-level nuclear waste in one step and, at the lab-level, has reduced the volume of high-level waste twenty-fold. The scientists, from the Idaho National Engineering and Environmental Laboratory and the Khlopin Radium Institute in Russia, last month received an $800,000, three-year grant from DOE's Environmental Management Science Program to further study and improve the technology. The UNEX process is analagous to the PUREX plutonium-separation process used at the Savannah River Site to separate plutonium from spent nuclear fuel, according to INEEL chemical engineer Scott Herbst, who leads the research team developing the new technology. Liquid waste is pumped from holding tanks into the UNEX system, where centrifugal contacts transport target nuclides to an organic phase. Those organics are then scrubbed to extract unwanted elements which were separated along with the targets, and the remaining solution is then sent to a stripper, which removes the extracted nuclides from the organics, resulting in an aqueous stream containing only the target nuclides. "One of the good things about this process is the organics are perpetually recycled," Herbst said. "The outputs are low-level waste, tank waste free of the target nuclides, and a strip solution containing the targets. The low-level waste can be disposed of in grout, for example, and the high-level components can be sent to a repository."

Twenty-Fold Reduction

The joint technology-development project emerged from a cooperative agreement struck with scientists in Russia in the early 1990s, DOE officials explained. In 1994, INEEL scientists traveled to Russia to exchange the technologies each country had independently developed for nuclear waste cleanup. "They had up and operating a process for removing Cesium-137 and Strontium-90 from liquid waste," Herbst explained. "We started looking at that process, and added an actinide extractant, changing the chemistry of their system to strip all three targets." The UNEX process reduces the volume of high-level waste at least twenty-fold, with each gallon of high-level liquid waste reduced to less than a cup. That twenty-fold volume reduction leads to a corresponding reduction in disposal costs. Herbst and his American and Russian colleagues have run samples of actual high-level waste, including dissolved samples of calcined INEEL waste, through the UNEX system on a lab-scale to demonstrate the system's efficacy, but they still understand little about how the process actually works. That could all change, however, as Herbst and his team last year were awarded a three-year, $800,000 grant by the DOE Environmental Management Science Program to study the mechanisms of separation. "We have never been able to step back and understand on a fundamental, molecular scale, how this process works," Herbst said. "The EMSP money will help us understand the basic processes, and that will help us identify ways to improve the efficiency of the system."

Few Problems

The process, as developed, is amenable to acidic waste such as the high-level waste stored at INEEL, but Herbst believes the process also can work on basic waste, particularly for cesium and strontium removal. The separation technology hasfew inherent technical problems, Herbst said, although some technical difficulties may arise depending on how the final aqueous stream is treated. "For example, for vitrification, there may be concerns with the melter," he said. Herbst's

team on the UNEX project includes Vasily Babain and colleagues at the Khlopin Radium Institute in St. Petersburg, Russia, and Sue Clark at Washington State University. His colleagues at INEEL include Tom Luther, Fred Stewart, Terry Todd, Jack Law, Dean Peterman and George Redden.